

type of coaxial cable for the traps. The dc resistance of 40.7 Ω per 1000 feet of RG-59 coax seems rather high. However, W8NX has found no coax other than RG-59 that has the necessary inductance-to-capacitance ratio to create the trap characteristic reactance required for the 80, 40, 20, 15 and 10 meter antenna. Conventional traps with wide-spaced, open-air inductors and appropriate fixed-value capacitors could be substituted for the coax traps, but the convenience, weatherproof configuration and ease of fabrication of coaxial-cable traps is hard to beat.

Project: Extended Double-Zepp for 17 Meters

Although the Extended Double-Zepp (EDZ) antenna shown in **Fig 21.42** has several attractive features, it is rarely used by hams, perhaps out of concern over the Zepp's high feed point impedance. The antenna's overall length is 1.28λ and its pattern is bidirectional broadside to the antenna. The SWR of the antenna is low enough near the design frequency that it can be fed with coax and an impedance-matching unit or open-wire line can be used for wider range and multiband use. This project describes an EDZ for 17 meters.

The Zepp antenna (a half-wave dipole, fed at one end) was introduced earlier in this section. The Zepp can be modified in two ways. The first is to double the length of the antenna and feed it in the middle, making a *double-Zepp*. This creates a one-wavelength dipole, with the expected high feed point impedance and about 1.6 dBd gain. A $\frac{1}{2} \lambda$ center-fed

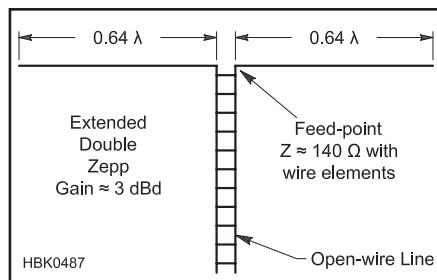


Fig 21.42 — The Extended Double-Zepp antenna consists of two 0.64λ sections placed end to end and fed in the middle. The high-impedance points of the antenna have been moved away from the feed point, lowering feed point impedance. The antenna has gain of approximately 3 dBd broadside to the antenna.

dipole operated on its second harmonic is effectively a double-Zepp. The second modification is to extend the double-Zepp to be 0.64λ (close to $\frac{3}{4} \lambda$) long on each side of the feed point. The feed point is then no longer at a high-impedance point on the antenna. This creates the extended, double-Zepp. (The EDZ is described in more detail in the *ARRL Antenna Book*.)

The overall length of the EDZ is calculated as follows:

$$984/f(\text{MHz}) \times 1.28 = \text{length in feet} \quad (5)$$

Using this formula, an 18.1 MHz EDZ is 69.6 feet (69 feet, 7 inches.) long. The EDZ has 3 dBd of gain in a figure-8 pattern of two major lobes broadside to the antenna and four minor lobes at smaller angles to the axis of

the antenna. The feed point impedance is approximately 140 Ω .

The EDZ is useful at lower frequencies, as well. On 20 meters, the 17 meter EDZ is just slightly longer than the double-Zepp, with 1.6 to 2 dBd of gain and a rather high feed point impedance of several hundred ohms. On 40 meters, the antenna is a slightly long $\frac{1}{2} \lambda$ dipole. If your antenna tuner has sufficient range, the antenna can also serve as a shortened dipole for 75/80 meters. At these lower frequencies, the antenna's radiation pattern is a single lobe, broadside to the antenna.

On higher frequencies, the pattern continues to split into more lobes. For example, on 15 meters, there are four lobes at approximately 45° from the antenna axis. On 10 meters, where the antenna is approximately two full-wavelengths long, the pattern is similar, with the lobes a bit closer to the antenna axis and smaller lobes beginning to appear.

Some hams use a 4:1 impedance transformer to reduce the feed point impedance and improve SWR as the operating frequency moves away from the design frequency. This works best if the antenna is to be used on a single band. However, if the antenna is to be used on multiple bands, a better solution is to use open-wire feed line and an antenna tuner. If you wish to operate on a frequency at which the feed point impedance is high, use a feed line length near an odd multiple of a quarter-wavelength long, presenting a lower impedance to your antenna tuner that may be easier to match.

(This project is based on a "Hints and Kinks" item by Bob Baird, W7CSD, from the January 1992 issue of *QST*.)

21.3 Vertical (Ground-Plane) Antennas

One of the more popular amateur antennas is the *vertical*. It usually refers to a single radiating element erected vertically over the ground. A typical vertical is an electrical $\frac{1}{4} \lambda$ long and is constructed of wire or tubing. The vertical antenna is more accurately named the *ground plane* because it uses a conductive surface (the ground plane) to create a path for return currents, effectively creating the "missing half" of a $\frac{1}{2} \lambda$ antenna. Another name for this type of antenna is the *monopole* (sometimes *unipole*).

The ground plane can be a solid, conducting surface, such as a vehicle body for a VHF/UHF mobile antenna. At HF, this is impractical and systems of *ground radials* are used; wires laid out on the ground radially from the base of the antenna. One conductor of the feed line is attached to the vertical radiating element of the antenna and the remaining

conductor is attached to the ground plane.

Single vertical antennas are omnidirectional radiators. This can be beneficial or detrimental, depending on the situation. On transmission there are no nulls in any direction, unlike most horizontal antennas. However, QRM on receive can't be nulled out from the directions that are not of interest unless multiple verticals are used in an array.

Ground-plane antennas need not be mounted vertically. A ground-plane antenna can operate in any orientation as long as the ground plane is perpendicular to the radiating element. Other considerations, such as minimizing cross-polarization between stations, may require a specific mounting orientation though. In addition, due to the size of HF antennas, mounting them vertically is usually the most practical solution.

A vertical antenna can be mounted at the

Earth's surface, in which case it is a *ground-mounted vertical*. The ground plane is then constructed on the surface of the ground. A vertical antenna and the associated ground plane can also be installed above the ground. This often reduces ground losses, but it is more difficult to install the necessary number of radials. *Ground-independent* verticals are often mounted well above the ground because their operation does not rely on a ground plane.

21.3.1 Ground Systems

When compared to horizontal antennas, verticals also suffer more acutely from two main types of losses — *ground return losses* for currents in the near field, and *far-field ground losses*. Ground losses in the near field can be minimized by using many ground radi-